LIPID PROFILE IN TERM, PRETERM AND STRESSED NEW BORN BABIES.

THESIS

For

DOCTOR OF MEDICINE

(PAEDIATRICS)

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JHANSI (U. P.)

1996 SURENDRA NATH

C E R T I F I C A T E

This is to certify that the work in connection with thesis of DR. SURENDRA NATH, on "LIPID PROFILE IN TERM, PRETERM AND STRESSED NEWBORN BABIES", for M.D. (Paediatrics) of Bundelkhand University, was conducted in the Department of Paediatrics.

He has put in the necessary stay in the department according to University regulations.

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C E R T I F I C A T E

This is to certify that the work on "LIPID PROFILE IN TERM, PRETERM AND STRESSED NEWBORN BABIES", which is being submitted as a thesis for M.D. (Paediatrics), by DR. SURENDRA NATH, has been carried out under my direct guidance and supervision in the Department of Paediatrics. The techniques embodied in the thesis were undertaken by the candidate himself and observations recorded have been periodically checked by me.

He has fulfilled necessary requirement of stay in the department for the submission of the thesis.

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C E R T I F I C A T E

This is to certify that the work on "LIPID PROFILE IN TERM, PRETERM AND STRESSED NEWBORN BABIES", which is being submitted as a thesis for M.D. (Paediatrics), by DR. SURENDRA NATH, has been carried-out under my guidance and supervision in the Department of Paediatrics and Obstetrics & Gynaecology. The technique embodied in the thesis was undertaken by the candidate himself and observation recorded have been periodically checked by me.

He has fulfilled necessary requirements for the submission of thesis.

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C O N T E N T S

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I N T R O D U C T I O N

INTRODUCTION

The rapidly sweaping pandemic of ischaemic heart disease has lead to a search for newer strategies to prevent atherosclerosis in its early stages. Because of a greater risk of developing premature accelerated coronary atherosclerosis early detection of children with familial hyperlipoproteinaemia with subsequent dietary intervention seems to be an attractive approach.

Recently, interest in cord lipid has increased because serum lipids disorders have their roots in childhood and atherogenic changes are postulated to originate in early life. So much so, atherosclerosis is being thought of as a pediatric problem.

Cord blood lipid levels are much less likely to be influenced by extraneous factor as compare with that in any other period of life. A general dissimilarity between the cord blood and maternal cholesterol and triglyceride levels has been described at the time of parturition suggesting that maternal lipids and lipoprotein do not cross the placental barrier (Kaplan and Lee, 1965). However, some evidence have been gathered to suggest that ante-partum factors such as maternal hypertension,

antepartum haemorrhage, foetal anoxia or intrapartum compromise such as prolonged labour and leaking per vaginal, muconeum stained liquor amni and post maturity may be associated with hyperlipidaemia (Tsang et al, 1974, Cress et al, 1977).

It has been suggested that hyperlipoproteinaemia can be diagnosed at birth by elevated levels of umbilical cord cholesterol, although opinion to the contrary have been offered and babies with elevated cholesterol at birth had values distributed through normal range when re-examined at one year age (Dermandy et al, 1972).

In small for date babies with intra-uterine malnutrition which favours adipose tissue break-down liberating free fatty acids. The portion of free fatty acids which escapes oxidation for energy is converted in the liver into triglyceride, resulting into rise in blood triglyceride levels. Full term baby on the contrary are in receipt of ready placental supply of nutrient so there is little need of lipolysis in utero (Haridas et al, 1984). Pre-term delivery is not a physiological phenomenon and it involves some amount of stress to fetus which may or may not be manifest clinically (Kumar et al, 1989). Stress in any form has been shown to raise serum triglyceride levels (Cress & Shahar, 1977).

Before birth fetus utilizes, carbohydrates as the major fuel. After birth, with cutting off of the nutrients from maternal circulation and before milk feeding established, the new born has to depend on its own endogenous sources of nutrients for survival. As the carbohydrate store of body are meagre and protein metabolism can account for only a fraction of the total energy requirement, body fat become a major source of energy for the newly born infants. Increased mobilization of lipid from stores and increased lipolysis in the immediate post natal period have been shown in the normal newborn infants by demonstrating a rise in the level of total lipids. Cholesterol, phospholipid and free fatty acid after birth (Persson B, Gentz J, Keele DK, Kay JL 1966).

The assessment for hyperlipidemia can be done by serum cholesterol, serum triglyceride, serum lipoprotein, serum free fatty acid assays. But simple cholesterol and triglycerides estimation is still retained as preliminary screening tests and it is possible that quantitation of cord blood cholesterol and triglycerides might provide a rapid, easily available and inexpensive measures that could be used prospectively to forecast hyperlipidemia and atherogenic problem and retrospectively might provide a means of reviewing materno-fetal factors that could have contributed to fetal distress.

Therefore present study is undertaken to determine the normal value of umbilical cord blood lipid in the local population and its correlation with gestational age, birth weight and stress newborn.

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AIMS AND OBJECTIVE

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1. To find out the normal values of umbilical cord lipid levels in term baby.

2. To find out the influence of prematurity and intra-uterine growth retardation on the cord lipid levels.

3. To find out the influence of perinatal stress on cord lipid levels.

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REVIEW OF LITERATURE

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Lipids are a heterogenous group of compound related either actually or potentially to fatty acids. They have the property of being relatively water insoluble and soluble in non-polar solvent such as ether, chloroform and benzene.

Lipids are important because of their high energy value, importance of fat soluble vitamins.

Bloor (1969) has classified lipids into simple, compound and derived lipids. Simple lipids are esters of fatty acid with various alcohols. They includes fats (cholesterol and triglycerides) and waxes. Compound lipids are esters of fatty acid containing groups in addition to an alcohol and a fatty acid. They include phospholipid, cerebroside and other compound lipid. Derived lipids are substances derived from the above mentioned groups by hydrolysis. They include fatty acids (saturated and unsaturated), glycerols and steroids.

There are dramatic changes in many biochemical, physiological and anatomic function which take place as a result of birth and continue during the first hours, days and even weeks of extrauterine life. Common to all changes

are the needs for satisfactory energy supply and lipid used as main energy substrate.

Cross and co-worker (1957) found the respiratory quotient (R.O.) of the newborn infants at birth to be 1.0, which began to fall shortly after birth and that it fell to a level close to 0.7 by the third day of life.

$$R.O. = \frac{\text{Rate of } CO_2 \text{ output}}{\text{Rate of } O_2 \text{ uptake}}$$

$$C_6 H_{12} O_6 + 6\ O_2 \text{ —— } 6\ O_2 + H_2O = 6/6 = 1.0$$

$$C_{57} H_{104} + 80\ O_2 \text{ —— } 57\ CO_2 + 57\ H_2O = 57/80 = 0.71$$

(Triolein)

Triolein is the most abundant fat in the body. A fall of this magnitude in R.O. is usually acceptable evidence of a change from the utilisation of carbohydrate to the utilisation of fat as a source of calories. Although the R.O. of the newborn must be cautiously interpreted (James, 1964) fat metabolism appears to be an important means of obtaining energy in the fasting newborn (Smith 1959). Furthermore a progressive rise in blood ketone occurs within a few hours after birth and reaches a peak in 2 to 3 days indicating increased oxidation of free fatty acid.

CHOLESTEROL :

Cholesterol is a complex monohydric secondary alcohol, stable white crystalline substance, insoluble in water but readily soluble in non-polar solvents. Chemically the basic structure consist 27 carbon atom ring referred to as cyclopentenoperhydrophenanthrene ring. It is widely distributed in all cells of body. The total cholesterol content of the body is about 200 mg/kg of body weight (Bell et al, 1972). Two third of cholesterol in blood is found in esterified form, while one third is present as free cholesterol (Fredrickson et al, 1967).

Cholesterol Metabolism :-

Most of tissue primarily of skin and intestine have the capacity to synthesize cholesterol (Srare et al, 1950). The rate of cholesterol synthesis is high in liver, intestine and skin and accounts for as much as 90% of total body cholesterol production, while it is low in other body tissue.

Dietary cholesterol is absorbed in intestine in company with other lipids and is incorporated in chylomicrons and very low density lipoprotein (VLDL). 80-90% absorbed cholesterol undergoes esterification, which may take place in intestinal mucosa. Chylomicron deliver thin cholesterol to liver from where it is transported to plasma

in form of VLDL which ultimately changes to low density lipoprotein (LDL) (Conner, 1979).

PLASMA TRIGLYCERIDES AND CHOLESTEROL TRANSPORT :

Ultimately LDL is taken up and broken down by extrahepatic parenchymal tissues and cholesterol is delivered to cells and cellular cholesterol synthesis is influenced by the lipid composition of the medium. The main enzyme in this process is "3 hydroxy 3 methyl glutaryl coenzyme-A-reductase" which can be induced by cholesterol deprivation.

EXCRETION :

It occur mainly by two pathways. One being conversion to bile acid and its excretion while the other being excretion of neutral sterol in faeces. Liver is the main organ for cholesterol disposal. Before elimination, cholesterol must enter in liver and be excreted in bile either as cholesterol or cholic acid. Loss through urine is negligible.

TRIGLYCERIDES :

Triglycerides are esters of fatty acids and glycerol. Human adipose tissue consists chiefly of triacylglycerols regardless of anatomical location. Triglycerides form the largest portion of dietary fat.

Metabolism :- Triglyceride metabolism is said to have two pathways namely exogenous and endogenous pathway.

Exogenous pathway of triglyceride metabolism (Fredrickson et al, 1967) :

In adults 1.2 gm/kg of triglycerides are ingested daily (Henry, 1977). From the intestinal mucosa, they are largely absorbed as chylomicrons and reach the blood through thoracic duct. These chylomicrons are taken to adipose tissue and skeletal muscles and then triglycerides are hydrolysed there to release free fatty acids and mono-glycerides. Free fatty acids are either re-esterified and stored in the adipose tissue and skeletal muscle or oxidised (Havel, 1961).

Endogenous pathway of triglyceride metabolism :

Endogenous hyperlipidemia perhaps first become a distinctly recognizable phenomenon, when Watkin et al (1950) noted that fat free high carbohydrate diet increased the triglyceride concentration.

Liver is considered as the major site for endogenous triglyceride metabolism (Havel, 1962 and Goldstein, 1961). An important source of fatty acids needed for triglyceride synthesis is the plasma free fatty acid. The flux of the free fatty acids into the liver, heart and skeletal muscles, is governed by their rate of release from adipose tissue.

Any factor that increases lipolysis or decreases glycerol esterification in the adipose tissue causes out-pouring of free fatty acid (Steinberg and Vaughan, 1965). Much of these fatty acid removed by liver and excess beyond what it can use or store is resynthesized into glyceride and resecreted as VLDL (Havel, 1957). VLDL is the chief triglyceride binding lipoprotein present in the plasma. VLDL particles carry 5-10 times triglycerides than cholesterol esters.

LIPOPROTEINS :

These are globulin particles of high molecular weight and transport non-polar lipids (cholesterol and triglycerides) through plasma. Each lipoprotein particles contains a non-polar core, comprising of triglycerides and cholesterol in varying proportions. Surrounding the core is a polar surface coat of phospholipids that stabilize the lipoprotein particles, so that can remain insoluble in the plasma. Surface coat consist of phospholipids, esterified cholesterol and apoprotein. The proportion of these lipids and proteins however, differ greatly resulting in differences in physiochemical properties which permit their separation (Chait, A, 1978).

Boydd, Nobbe and Schettler (1967) have classified lipoproteins into 4 major classes that are normally present in plasma.

Metabolism in Fetus :-

Before birth, fetus utilizes carbohydrate as the major fuel for energy production. This correlates well with the observation that the respiratory quotient (R.O.) in fetus and birth is one (James, 1972). In utero transfer of glucose occur through placenta. Free fatty acids have been shown to cross placenta but there is little or no transfer from mother to fetus of cholesterol, triglycerides or phospholipids (Forfar and Arneil, 1984). The synthesis of lipids in fetus proceeds from glucose and fatty acid precursors in early stage of gestation and lipid content in fetus increase to 300 fold from first month to nine month of gestation (Roux et al, 1974). After birth with cutting off of the nutrients from maternal circulation and before milk feeding is started the newborn has to depend on its own endogenous source of nutrients for survival. As the carbohydrate stores of body are meagre and protein metabolism can account for only a fraction of the total energy requirements, body lipids become a major source for energy for newly born infants. Increased mobilisation of lipid from the stores and increased lipolysis in the immediate post-natal period lead to a rise the levels of total lipids, cholesterol phospholipids and free fatty acids (Brown et al, 1939; Van Duyne, 1959; Persson, 1956 and Christensen, 1974). The mechanism for the oxidation of fatty acid rapidly increases in activity after birth (Forfar and Arneil, 1984).

However, information on this aspect of lipid metabolism is meagre in the case of premature, term and stressed newborn, as is evident from a brief review of the preceeding so far on this aspect.

It was some 82 years ago, when cord blood lipid measured for the first time by Hirmann and Neumann (1912) when they performed a study on 30 normal delivery and recorded the maternal and cord cholesterol levels with aim to find out the two value. They observed that the cord blood cholesterol (62 mg/dl) values were considerably lower in comparison to their maternal counterpart (mean value 264 mg/dl).

Gyorgy (1924) observed 6 cases and recorded the cord blood cholesterol and lipid phosphorous value and compared them with maternal serum counterparts. He chose 6 normal full term healthy deliveries which formed his study group. He observed that the mean values of serum cholesterol in cord and maternal blood were 69 mg/dl and 255 mg/dl respectively. These results showed that the value observed of cord blood cholesterol were comparable with those observed earlier and at the same time were less in comparison to material serum values. This finding also supported those by earlier workers. The serum lipid phosphorous values in cord blood were less in comparison to maternal serum lipid phosphorous value.

Gordon and Cohn (1928) conducted a study on 16 full term normally delivered cases to record their cord blood cholesterol levels and lipid phosphorous levels. They observed that the mean cord cholesterol value were 89 mg/dl which were slightly higher than those recorded by earlier workers, while the mean cord lipid phosphorous value were 4.1 mg/dl which were comparable to those observed by other workers. Here the aim was to establish the normal value and no correlation with maternal values was considered.

Sperry (1936) observed cholesterol value in cord blood of 7 neonates and found that mean values were 61 mg/dl which were in close approximation to those obtained earlier.

Sodowaky et al (1947) performed a study on 14 neonates who were delivered normally and observed the cord and maternal cholesterol values. In their study they found the mean cord blood cholesterol value to be 107 mg/dl which was higher than those observed by earlier workers, while the maternal mean blood cholesterol value were 262 mg/dl which were comparable to earlier obtained value.

Rofstedt et al (1954) studied 32 neonates to observe the cord blood cholesterol and lipid phosphorous values. The mean cord cholesterol value was observed to be 67 mg/dl which was consistent with other observation, while the mean lipid phosphorous value were 4.8 mg/dl which also was in close proximity to those obtained by other workers.

In their study Rafstedt et al reported that cord plasma lipid concentration were the same in low birth weight babies as compared to those of normal birth weight but this data was limited to cholesterol and total lipid concentration and the low birth weight babies were not subdivided into pre-term and small for date groups.

Russ et al (1954) have determined lipoprotein, cholesterol and phospholipid content in mother and their newborn infants. They recorded mean cord blood cholesterol values as 68 mg/dl while the mean maternal values were 282 mg/dl. These value correlated well with those observed in the past.

Brown et al (1959) performed a study on 50 neonates and their mothers to determine normal value of various serum components including proteins, lipoprotein and lipids at birth and their relation with corresponding maternal values. The maternal venous blood sample were collected during Ist stage of labour and cord blood samples were collected just after birth. The mother chosen underwent normal full term labour. The protein levels in maternal blood were 6.32 ± 0.52 gm%, 2.27 ± 0.33 gm% for total and albumin respectively and were 6.13 ± 0.64 gm% and 3.05 ± 0.45 gm% respectively in the cord blood samples for the same. The maternal values were 1104 ± 172 mg%, 257 ± 71 mg%, 847 ± 176 mg% and 273 ± 52 mg% for total

lipids, lipoprotein lipids, Beta lipoprotein lipids and cholesterol respectively, while they were 371 $\pm$ 75 mg%, 147 $\pm$ 40 mg%, 224 $\pm$ 41 mg% and 82 $\pm$ 17 mg% respectively for the same in the cord blood samples. These finding agreed closely with those of Rofstedt et al (1954) and Russ et al (1954).

Brody and Carlson (1962) included 52 Swedish cases in their study and observed the cord blood cholesterol, triglyceride and lipid phosphorous values. They included full term deliveries in their study. Their aim were to observe the normal cord blood cholesterol value and its relation with those observed in past as well as to observe the normal value of cord blood triglyceride levels. The mean cord blood cholesterol level observed by these authors was 66 mg/dl, cord triglyceride level was 34 mg/dl and lipid phosphorous level was 4.2 mg/dl. The level of cholesterol and lipid phosphorous were in proportion to previous recordings.

The observation of Kleenberg and Polishuk (1963) of 129 cases have revealed mean cord and maternal blood cholesterol value of 66 mg% and 261 mg/dl respectively. Both these observation have been a confirmation of the past recording. In fact, it was the largest study till date, but it did not consider gestational age or birth weight as the further differentiating criteria.

Keplan and Lee (1965) undertook a study on 56 cases and collected maternal and cord blood samples from 56 unselected pregnancy cases, at the time of delivery. Later infants cord blood sample was also collected and cholesterol, triglycerides and lipid phosphorous were estimated.

The mean cholesterol concentration was 95 $\pm$ 18 mg/dl in cord blood and 264 $\pm$ 56 mg/dl in maternal blood, mean triglyceride concentration was 34 $\pm$ 14 mg/dl in cord blood and 159 $\pm$ 54 mg/dl in maternal blood, while mean lipid phosphorous value was 5.3 $\pm$ 1.0 mg/dl in cord blood and 12.9 $\pm$ 2.4 mg/dl in maternal blood.

This study confirm the finding of Brody and Carlson (1962) that the concentration of serum triglycerides is quite low in the cord blood of newborn. Employing a method similar to theirs for the estimation of this constituent, it was found that the level of triglyceride was same in both studies while there was a significant difference in the cholesterol levels. The mean cholesterol level in cord blood was 95 mg/dl in contrast to 67 mg/dl and 66 mg/dl as observed in studies by Rafstedt et al (1954) and Brody and Carlson (1962).

This study also demonstrated that cord blood triglycerides were lower in cord blood in comparison to maternal value. The authors had ascribed the differences

in the maternal and cord blood lipid values to failure of lipids to pass through placental barrier. They also considered differences in fetal and adult metabolism to be responsible for the same, or perhaps the quiescent state of fat utilisation in the fetus and the absence of a need for fat mobilization may also be responsible for low serum triglyceride concentration in the cord blood samples.

Darmandy et al (1972) worked out on 302 cases and conducted a prospective study of serum lipid in infants throughout first year of life. The purpose of the study was to establish the relationship between cord serum cholesterol levels and the values subsequently achieved in individual babies, to determine, whether a diagnosis of hypercholesterolemia could be made with certainty during the first year of life. In addition the normal values for this period were also obtained. Cord blood was obtained from 302 full term babies, just after birth. Later blood samples were collected by capillary puncture from heal or finger at 1 week, 6 weeks, 4 months, 8 months and 1 year of age and cholesterol values were estimated.

The mean cholesterol values observed by these workers were 78 $\pm$ 23 mg/dl, 155 $\pm$ 31 mg/dl, 155 $\pm$ 31 mg/dl, 184 $\pm$ 36 mg/dl, 195 $\pm$ 37 mg/dl, 191 $\pm$ 36 mg/dl in cord blood, at 1 week, 4 weeks, 4 months, 8 months and 1 year of age respectively. Only one case had cord cholesterol value

of more than 100 mg/dl. The value for female were on a higher side than males. Out of 274 cases studied at 1 year age, 24 had cholesterol values more than 240 mg/dl, out of 23 cases had positive family history of hypercholesterolemia. The worker suggested that cholesterol value at 1 year age were a more reliable indicator of familial hyperlipidemia in comparison to cord cholesterol values.

Fosbrooke et al (1973) conducted a study to elucidate the effects of gestational age and nutritional status on the concentration and composition of cord blood lipid, so as to obtain the evidence concerning intra-uterine fat metabolism. Plasma lipid concentration and fatty acid composition were determined in the cord blood of three groups of babies. The first group was of low birth weight pre-term babies, the second group include full term low birth weight babies and third group (reference group) included full term normal weight babies.

The values of cord blood cholesterol derived at this study were 96 $\pm$ 18.7 mg/dl for preterm (less than 37 weeks), 97.2 $\pm$ 31.5 mg/dl for term babies (37 - 41 weeks) and 82.4 $\pm$ 22.9 mg/dl for light for date babies (37-41 weeks) while at the same time the cord blood triglyceride levels were 19.8 $\pm$ 7.8 mg/dl, 29.6 $\pm$ 12.0 mg/dl and 45.4 $\pm$ 28.2 mg/dl respectively in the above mentioned group. The total concentration of cholesterol did not vary much between these group. Triglyceride level were higher in term and was

highest in the light for date babies. There was a significant correlation between the triglyceride concentration of the appropriate weight babies and gestational age, but inspection of individual values showed that the concentration varied little before 37 weeks and then increased substantially in babies born after 37 weeks of gestation. Triglyceride concentration in the 'light for date' group were higher than in appropriate weight babies. It was also observed that in babies delivered beyond 28 weeks of gestational age, the cholesterol concentration were not related to gestational age or nutritional status.

The lower triglyceride concentration in the preterm reflected lesser importance of fat metabolism earlier in pregnancy and as deposition of fat in adipose tissue took place mainly in the last month of pregnancy. The higher triglyceride concentration in the light weight for the date infants were compared by authors to those found in marasmic children due to malnutrition developing post natally. The authors related them with mobilisation of intrauterine fetal adipose stores in response to intrauterine malnutrition.

Tsang et al (1974) focussed their attention on neonates found to have elevated cord triglyceride levels during a survey of 2000 consecutive unselected live births.

They selected 60 infants by cholesterol screening programme using parental cholesterol triglyceride values by judging them against the normal ones as suggested by

Fridrickson and Levy (1972). Factors such as maternal hypertension, diabetes, prolong labour, prolong rupture of membrane, malpresentation, gestational age, post-term delivery, low apgar score were not considered while selecting the cases.

57 infants were selected in another group in which one of the parents had hypertriglyceridemia with normal to slightly elevated cholesterol levels. The above mentioned materno-fetal factor were not considered while selecting the cases. This group was used as a second control in addition to former group of infants, as it represented a group with some genetic potential for eventual development of hypertriglyceridemia.

In this distribution curve the 95th percentile value for cord triglyceride was determined as 70 mg/dl and this was taken as a cut-off between normal and elevated levels.

In 60 neonates born to parents with normal cholesterol and triglyceride values, mean cord blood triglyceride levels were 36 $\pm$ 18 mg/dl with a range of 8 - 95 mg/dl. In 57 neonates born to parents where one of them had hypertriglyceridemia, the mean cord triglyceride levels were 37 $\pm$ 19 mg/dl. Both the above mentioned control group had values comparable with each other.

In 2000 consecutive live births, 56 neonates had cord triglyceride level more than 70 mg/dl (cut-off point),

mean value being 111 $\pm$ 33 mg/dl and the range being 71 to 218 mg/dl. 46 normal neonates with cord triglyceride levels less than 70 mg/dl, mean values 30 $\pm$ 16 mg/dl and range 1 - 70 mg/dl, were selected as controls. These two groups were estimated against maternofetal factor and cord triglyceride levels were observed to be related with perinatal stress factors.

In the group of hypertriglyceridemia neonates (56 cases) 36 (20/56) cases had maternal hypertension, 21% (12/56) cases had prolonged labour, 21 (12/56) had cord around neck, 43% (25/56) had muconeum stained amniotic fluids 54% (30/56) were post-term deliveries and 36% (20/50) had decreased 1 minute apgar score while in the control group (46 cases) the incidence of above mentioned perinatal stress factors was 4.3% (2/46), 0% (0/46), 2.2% (1/46), 11% (5/46), 6.5% (3/46) and 2.2% (1/46) respectively. There was no association between triglyceride levels and maternal diabetes, prolong labour, prolong rupture of membrane, caessarean section, abnormal presentations, sex of child, low birth weight for gestation (small for date) there was a linear relationship between total number of significant perinatal factors and cord triglyceride levels. There was also an inverse relationship between cord blood triglyceride level in 102 neonates (56 cases and 46 controls) and one minute apgar score.

The authors suggested that stress in utero or birth canal, or anoxia may lead to early mobilization and depletion of glycogen stores and an early conversion to oxidation of fats, thereby causing hypertriglyceridemia in neonates affected with perinatal factors leading to stress. The authors suggested cord blood hypertriglyceridemia as a useful indicator of antipartum or intrapartum fetal stress or compromise.

Desai et al (1977) studied and analysed 113 full term newborns, delivered by normal labour following uncomplicated pregnancy. The mean birth weight was 2800 gm with a range of 2500 to 3600 gm. The cord cholesterol values ranged between 35 - 128 mg/dl and phospholipids between 58 - 160 mg/dl, while the mean values were 79 $\pm$ 17 mg/dl, 62 $\pm$ 21 mg/dl and 95 $\pm$ 17 mg/dl respectively.

The levels of cholesterol in this study were in agreement with previous recording while the levels of triglyceride observed in this study was higher than those obtained earlier by western authors.

Cress et al (1977) observed 275 neonates for cord blood cholesterol and triglyceride levels and noted cord blood cholesterol level as 70 $\pm$ 17 mg/dl with a range of 30 $\pm$ 153 mg/dl. The 95th percentile value was 105 mg/dl. Mean cord blood triglyceride level were 33 $\pm$ 16 mg/dl with a range of 5 - 192 mg/dl. The 95th percentile value for

cord blood triglyceride was 77 mg/dl. They observed that out of 22 neonates whose cord blood lipid values exceeded the 95th percentile values, 9 had hypercholesterolemia and 13 had hypertriglyceridemia. Four neonates had elevated values both cholesterol and triglyceride range 103 - 120 mg/dl and 68 - 117 mg/dl respectively.

None of the 275 neonatal sera had demonstrable amount of IgA antibody, indicating that there was no maternal contribution to the cord blood samples.

Post term deliveries ($>$41 weeks) was seen in 20% (3/15) of newborn with increased cholesterol levels, 15% (3/20) of neonates with increased triglyceride level and 8% (5/65) of neonates with normal values.

One minute Apgar score of 6 or less was seen in 7% (1/15) of cases with hypercholesterolemia and 37% (7/19) of neonates with hypertriglyceridemia.

Resuscitation was required in 20% (3/15) of hyper-cholesterolemic neonates and in 21% (4/19) of hyper-triglyceridemic neonates, as compared with 12% (8/65) of normal controls.

Prolong labour (more than 15 hours) was observed in 13% (2/15) of infants with elevated cholesterol levels and in 11% (2/19) of infants with high triglyceride levels as compared with 9% (6/65) of normal infants.

Maternal hypertension present in mothers of 7% (1/15) of hypercholesterolemic infants and 21% (4/19) of hypertriglyceridemic neonates as compared to 1.5% (1/65) of mothers of normolipidemic infants.

In this study, it was seen that high cord blood cholesterol or triglyceride values were associated with maternal fetal problems related with unfavourable intra-uterine environment, fetal distress, fetal anoxia. There was a significant correlation between post term delivery and hypercholesterolemic neonates and low Apgar scores along with maternal hypertension were more associated with hypertriglyceridemia. Low cord blood lipid levels were seen after an uneventful pregnancy, with the Apgar score greater than 8.

The authors stated that during birth, newborn entered from a warm intrauterine environment to unpleasant cool atmosphere and during this period of adjustment, the energy requirements were provided by utilisation of carbo-hydrate and fat stores. The pituitary adeno-cortical axis was supposed to be capable of stimulating fetal lipogenesis at term and during stress of delivery. Catecholamine elicited an immediate response on adipose tissue. Neonatal stress associated with materno-fetal perinatal problem especially maternal hypertension, post term delivery. Low Apgar score were related to elevated cord blood cholesterol and triglyceride levels.

Prakash et al (1980) studied 50 newborn for serial estimation of free fatty acids. They included cases where the delivery was normal vaginal and mothers were sure of their first day of last menstrual period (LMP). Later on, the gestational age also assessed post-natally by Dubowitz's method. They classified 50 neonates into 3 groups on the basis of gestational age and birth weight as follows :- Control groups of full term appropriate for the date babies, small for gestational age group who were full term and weighed less than 2000 gm and pre-term group who were born before 37 weeks of gestational age. They observed the maternal value to be higher in all of above mentioned 3 groups than cord blood values. The cord blood levels of free fatty acids were higher (mean value 8.40 $\pm$ 0.14 mEq/l) in small for date group than control (mean value 0.38 $\pm$ 0.12 mEq/l) and pre-term group (mean value 35 $\pm$ 0.12 mEq/l). This difference was not significant ($P > 0.05$). However, significantly low values were observed in pre-term babies in comparison to control group ($P < 0.01$) at 3 hours of age.

The free fatty acid levels at various gestational ages were as follows : Upto 32 weeks, the cord blood levels were significantly lower (0.26 $\pm$ 0.06 mEq/l) in comparison to 33 - 36 weeks (0.05 $\pm$ 0.07 mEq/l) ($P < 0.05$). After 36 weeks levels did not differ significantly.

The authors expressed that the early rise in free fatty acid levels after birth was due to lipolysis and

release of free fatty acid from adipose tissue during course of utilisation for energy purposes.

A study was carried out on 57 neonates for cord blood lipid profile by Sharma et al (1983). They divided the 57 cases into 3 groups on the basis of gestational age and birth weight. The first group included normal term appropriate for gestational age newborns (31), the second group include full term small for gestational age infants (12) and third group included pre-term appropriate for gestational age infants (14). The classification was done according to Lubschenco et al (1963). The total lipid, cholesterol and free fatty acids in cord blood were estimated.

The cord cholesterol levels in normal full term, small for date and pre-term were 74 $\pm$ 17 mg/dl, 64.8 $\pm$ 12.3 mg/dl and 64 $\pm$ 13 mg/dl respectively while the cord blood phospholipid value were 112 $\pm$ 36.3 mg/dl, 101.6 $\pm$ 30 mg/dl and 130 $\pm$ 11 mg/dl respectively in above mentioned groups. The free fatty acid levels in cord blood were 0.38 $\pm$ 0.03 m mol/l, 0.29 $\pm$ 0.06 m mol/l and 0.26 $\pm$ 0.06 m mol/l in normal full term, small for date and pre-term respectively.

The levels of various lipid fraction in cord blood were seen to be lower in small for gestational age group (second group) and pre-term group (third group) as compared to healthy full term neonates (first group) and the

difference was statistically significant only with free fatty acid levels ($P \angle 0.001$) and attributed this to lower fat store in small for gestational age infants in comparison to full term healthy neonates. The lower values in pre-term infants were attributed probably to a possible quantitative or qualitative deficiency of the enzyme lipoprotein lipase which was responsible for release of free fatty acid from neutral fats (triglycerides). The lower level of enzyme have also been reported by Sigmura et al (1974) and Prakash et al (1980).

Haridas and Acharya (1984) conducted a study on 180 newborns and their mothers, who belonged to low socio-economic strata. This study consisted of determination of cholesterol and triglyceride value in cord blood and serum on 2nd, 3rd, 4th and 5th day in normal full term, pre-term and low birth weight babies along with maternal blood values.

The mean cord blood triglyceride values were 45 ± 13.8 mg/dl (range 20-89 mg/dl), 59 ± 22.3 mg/dl (range 24 - 119 mg/dl) and 56 ± 16.1 mg/dl (range 22-95 mg/dl) in normal full term, pre-term infants and small for date babies respectively. The triglyceride values were 157 ± 48.9 mg/dl (range 65 - 317 mg/dl), 135 ± 26.2 mg/dl (range 87 - 190 mg/dl) and 114 ± 41.2 mg/dl (range 71-343 mg/dl) respectively in mothers of above mentioned group infants.

The mean cholesterol values were 90 $\pm$ 17.7 mg/dl (range 55 - 125 mg/dl), 95 $\pm$ 20.2 mg/dl (range 42-130 mg/dl) and 91 $\pm$ 20.2 mg/dl (range 42 - 122 mg/dl) in cord blood of normal full term, pre-term and small for date infants, while they were 230 $\pm$ 34.9 mg/dl (range 120 - 330 mg/dl), 228 $\pm$ 37.6 mg/dl (range 143 - 292 mg/dl) and 233 $\pm$ 32.8 mg/dl (range 167 - 320 mg/dl) respectively in the mothers of the above mentioned infant groups.

The mean triglyceride values were 65 $\pm$ 13.8 mg/dl and 89 $\pm$ 17.1 mg/dl in normal full term infants on 2nd/3rd and 4th & 5th day respectively. The levels were 74 $\pm$ 15.3 mg/dl and 93 $\pm$ 16.4 mg/dl in small for date babies on the above mentioned day respectively. The cholesterol levels were 124 $\pm$ 9.6 mg/dl, 156 $\pm$ 9.6 mg/dl in normal full term, 119 $\pm$ 11.6 mg/dl and 143 $\pm$ 8.7 mg/dl in pre-term and 122 $\pm$ 7.2 mg/dl and 143 $\pm$ 7.6 mg/dl in small for date babies on 2nd/3rd and 4th/5th day respectively.

The neonatal cholesterol and triglyceride values were lower than maternal counterparts. The cord blood cholesterol levels were not significantly different in the three groups but by the 4th/5th day, normal full term babies exhibited higher values. The low birth weight and pre-term infants had higher triglyceride value in cord blood than normal full term. The levels continue to be higher in low birth weight babies and pre-term infants but the differences were statistically insignificant.

The difference in cord and maternal lipid values revealed lack of maternal contribution to fetal lipids. The authors stated that low birth weight infants were born with intrauterine malnutrition which favoured adipose tissue breakdown and liberation of free fatty acids. The portion of free fatty acid escaping oxidation for energy production were synthesized into triglyceride in the cord blood of low birth weight babies. The raised triglyceride levels in post-natal period was due to utilisation of adipose tissue for energy requirements as glucose was conserved for energy requirements of brain and erythrocytes. This liberated free fatty acids which lead to triglyceride synthesis and raised triglyceride levels. The post natal elevation in cholesterol levels was due to its enhanced synthesis as a result of increased enzyme and substrates required for cholesterol biosynthesis.

Mathur et al (1986) have done a study on 56 newborn for cord cholesterol values. These neonates delivered to healthy mothers, their gestational age was determined by Dobowitz's criteria. In this study out of 56 neonates, 14 were pre-term and 42 were term babies. The cord blood was collected from the placental end just after delivery. They observed mean cord blood cholesterol values to be as 105.27 $\pm$ 17.14 mg/dl with a range of 70 - 135 mg/dl. The mean cord blood value in preterm babies were 92.57 $\pm$ 14.94 mg/dl as compared to 112.2 $\pm$ 14.58 mg/dl in term babies.

In 18 babies weighing less than 2.5 kg the mean value were 93.67 ± 14.64 mg/dl while in 38 neonates weighing more than 2.5 kg the mean value were 110.76 ± 15.46 mg/dl. A positive correlation was found between birth weight and cord blood cholesterol levels in this study.

Kumar et al (1989) undertook a study to find out the influence of prematurity and/or growth retardation on the cord lipid levels. They included 73 newborns, delivered to healthy mother with uncomplicated pregnancy and labour. The cord was cut and clamped within 3 minutes of delivery but prior to delivery of placenta. Mixed arterial and venous blood was allowed to flow freely and contamination with maternal blood was avoided. The gestational age was assessed by first day of last menstrual period, supplemented with clinical evaluation by Ballard Score (1977). The newborn were divided into 4 groups on the basis of gestational age and birth weight. First group includes full term appropriate for gestational age babies, the second group included full term small for gestational age babies, the third group included preterm appropriate for gestational age babies and the fourth group included preterm small for gestational age babies. The cord blood cholesterol, triglyceride and free fatty acid value were determined.

Out of 73 neonates, 29 belonged to the first group, 17 belong to second group, 22 belonged to third group and

5 were of fourth group. The mean cord blood cholesterol value were 85.83 ± 22.85 mg/dl for first group, 84.35 ± 17.15 mg/dl for second group, 100.09 ± 32.19 mg/dl for third group and 92.20 ± 8.32 mg/dl for fourth group. These values showed no significant difference.

The mean cord triglyceride values were 35.27 ± 17.49 mg/dl, 53.34 ± 23.95 mg/dl, 70.67 ± 32.68 mg/dl and 104.50 ± 20.80 mg/dl for above mentioned groups respectively. These values were significantly higher in the full term, small for gestational age and pre-term small for gestational age groups, in comparison to their appropriate for gestational age counterparts.

The free fatty acid levels in various groups of neonates were 0.27 ± 0.14 m mol/l, 0.25 ± 0.10 m mol/l, 0.31 ± 0.11 m mol/l and 0.41 ± 0.07 m mol/l in full term appropriate for gestational age, full term small for gestational age, pre-term appropriate for gestational age and pre-term small for gestational age group respectively and showed that free fatty acid levels were significantly higher in pre-term small for gestational age group infants.

The workers concluded that cord blood cholesterol levels were not influenced by birth weight, gestational age and elevated cholesterol levels may indicate hyper-cholesterolemia. On the other hand, the levels of triglycerides and free fatty acids were affected by birth

weight and gestational and an infant should not be labelled as hyperlipidemic unless these factors were considered.

The authors stated that stress in any form has been shown to raised serum triglyceride levels. As pre-term delivery was not a normal phenomenon and it involved some amount of stress to fetus which could or could not manifest clinically. Small for gestational age babies were born with intrauterine malnutrition which favoured adipose tissue breakdown, liberating free fatty acids. The portion of free fatty acid which escaped oxidation for energy was converted to triglyceride in the liver, thereby resulting in increased triglyceride levels.

Lakhtakia et al (1990) performed a study on 100 neonates to detect the effect of familial hypertension on the cord blood cholesterol and triglyceride levels. They selected 50 cases where there was family history of essential hypertension (in mother, grand parents or in other siblings) and 50 control subjects who were full term delivered neonates, after normal labours, without any adverse fetomaternal factors, born in a family with no history of ischaemic heart disease, hypertension or diabetes mellitus.

The mean $\pm$ S.D. cholesterol values in cord blood of neonates with family history of hypertension with the involvement of parents, grand parents and siblings of parents were 123.24 $\pm$ 22.32 mg/dl, 93.7 $\pm$ 16.96 mg/dl and

88.0 ± 11.95 mg/dl respectively. The cord triglyceride levels in the above mentioned groups were 58.16 ± 17.52 mg/dl, 33.94 ± 16.7 mg/dl and 30.0 ± 13.16 mg/dl respectively.

The mean serum cholesterol levels in the study and control groups were 108.92 ± 26.25 mg/dl and 86.84 ± 26.62 mg/dl respectively. The mean triglyceride levels in the above said group were 45.52 ± 20.89 mg/dl and 28.72 ± 72.81 mg/dl respectively. The differences in the study and control groups regarding the cholesterol and triglyceride levels were highly significant ($P < 0.001$).

Jagdish Singh et al (1994) conducted a study on pre-term and term newborn to find out the serum cholesterol values in their cord blood. It is also suggested that hypercholesterolemia can be diagnosed at birth by estimation of total cholesterol or low density lipoproteins in umbilical cord blood. The present study was undertaken to determine the normal value of umbilical cord blood cholesterol in the local population and correlation with gestational age, birth weight and sex of the baby was established.

One hundred newborn delivered to healthy mothers with no family history of coronary artery disease, hypertension and diabetes mellitus. The gestational age was determined using the criteria laid down by Dubowitz et al. Cord blood samples were collected from the placental end of cord just after the delivery of baby and cholesterol was estimated.

Of total 100 newborn, term and pre-term were 78 and 22 respectively. 77 babies weighing >2.5 kg and 23 were of <2.5 kg. Boys and girls were 56 and 44% respectively.

The mean cord blood cholesterol ($\pm$ S.D.) level was 90.4 ± 18.2 mg/dl with a range of 51.4 - 126 mg/dl. In term babies the mean level was 96.2 ± 15.1 mg/dl as compared to 69.5 ± 10.9 mg/dl in pre-term ($p < 0.001$). The mean levels were 96.1 ± 15.0 mg/dl and 66.8 ± 16.0 mg/dl in babies weighing ≥ 2.5 kg and < 2.5 kg respectively ($P < 0.001$). Serum cholesterol value shows significant positive correlation with gestational age and birth weight. The mean cord level of cholesterol in boys was 88.7 ± 19.1 and in girls was 91.1 ± 17.2 mg/dl ($P > 0.05$).

A significant positive correlation was also found between cord blood cholesterol levels and birth weight, the same has been observed by Mathur et al. Sex of baby did not influence the cholesterol values as has been previously observed.

The authors recommend further evaluative studies to establish norms for various age groups. As prevention of undesirable consequences of hypercholesterolemia at an earlier age seems more logical, a follow-up of this cohort for next 2-3 decades will be aimed.

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MATERIAL AND METHODS

MATERIAL AND METHODS

The present study was carried out in the Department of Paediatrics, in active collaboration with the Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi. Babies delivered between August '94 to July '95 were included in this study.

Study group :

The study group consisted of 55 newborn babies delivered by normal vaginal and caesarean section. The newborn babies were classified according to their gestational age and birth weight criteria laid down by Lunchenco LO et al (1966). On the basis of gestational age, babies were divided into 3 sub-groups - Preterm babies ($<$ 37 weeks), term babies (37-41 weeks) and post-term babies ($>$ 41 weeks). According to birth weight, babies were further classified ascertaining their position on intra-uterine growth curve (Lubchenco LO et al, 1966).

1. Pre-term (gestational age less than 37 weeks) -

   (a) Small for gestational age (SGA), (Birth weight below 2 S.D.)

   (b) Appropriate for gestational age (AGA), (Birth weight upto 2 S.D.)

(c) Large for gestational age (Birth weight more than 2 S.D.).

2. Term Babies (Gestational age 37-41 weeks) -

(a) Small for gestational age (Birth weight less than 2 S.D.)

(b) Appropriate for gestational age (AGA), (Birth weight upto 2 S.D.).

3. Post-term Babies (gestational age 42 weeks or more) -

(a) SGA (Birth weight below 2 S.D.),

(b) AGA (Birth weight upto 2 S.D.).

The definition for the low birth weight babies as laid down by World Health Organization (WHO, 1961) was adopted in the present study to classify the babies with birth weight less than 2500 gms in low birth weight (LBW) group.

4. <u>Stressed Newborn</u> :- Baby delivered by lower segment caesarean section, Mother having pregnancy induced hypertension, Antepartum haemorrhage or prolong labour (more than 15 hours).

<u>HISTORY</u> :

This include obstetrical history, socio-economic history, and past history. In obstetrical history, parity, abortion, previous premature birth, still birth, neonatal

death, previous LSCS, prolong labour, PET, hydromnios, twin pregnancy were recorded in each case. Application of forceps at the time of previous deliveries was also recorded.

Emphasis was given in each case to record the history of last menstrual period and was recorded when the mother was sure of it. Gestational age was calculated in complete weeks from first day of last menstrual period and by the physical and neurological criteria laid down by Dubowitz et al (1970).

Antenatal, Natal and Post-natal History :

A detailed history of any medical or surgical disorder viz. anemia, convulsions, oedema, hypertension, cardiac disorder, antipartum haemorrhage, exanthematous fever, syphillis, gonorrhoea was recorded. History of drug intake and addition to narcotics, smoking etc. were also taken in each case. Multiple pregnancies were also considered in the history.

History was taken regarding the mode of delivery, duration of labour, leaking P/V, meconeum staining of liquur cry and activity of baby after birth, and cyanosis after birth to rule out any evidence of perinatal stress.

All newborn in this study were examined in detail with regard to Apgar score, birth weight, cry, activity, any congenital malformation, mode of delivery, duration of labour,

leaking P/V, muconeum staining of liquor amnii, cyanosis after birth.

Apgar scoring of baby was done at 1 minute and 5 minutes to detect any evidence of birth asphyxia.

Thorough clinical examination was done in each case. Head of newborn baby was examined in detail for the size of fontenelle, over-riding of skull bones, moulding, presence of caput succedaenium, cephalhaemetoma, shape of head and any mark of injury over head. Eyes were examined for any evidence of conjunctivitis or cataract. Detailed examination was done to find out any congenital anomalies. A thorough systemic examination of cardiovascular system, respiratory system, nervous system and abdomen was also done in each case.

Anthropometric measurements viz. head circumference, chest circumference, length were recorded. Birth weight of each case was recorded within 1 hour of delivery. Neonatal reflexes viz. feeding reflexes (Rooting, sucking and swallowing). Extensor reflexes (Moro's, tonic neck reflex, galants reflexes, Perez reflexes) progeession reflexes (stepping, placing reflex) were examined in each case. Assessment of gestational age was done by using the physical and neurological characteristics laid down by Dubowitz et al (1970). Ten neurological characteristics were scored from 0-5, while eleven physical characteristics were scored from 0-4 in a predesigned proforma and conversion of score into

gestational age was done by the following formula or by the conversion curve (Dubowitz et al, 1970).

Collection of Sample :-

Blood sample (5 ml.) was collected from the cut end of umbilical cord from the placental slide in a clean, sterilized vial with due precaution to avoid contamination with maternal blood and haemolysis. All the vials used in the study were thoroughly sterilized. Blood samples were allowed to clot at room temperature after 2-4 hrs, serum was separated using a pippette and then serum was centrifuged at 3000 - 4000 rpm for 5-10 minutes. After centrifugation 2 ml of clear serum at the top of sample was transfered to another dried vial with due marking on it. The samples were stored at +4^{o}C and were analysed within 6-7 days for cholesterol and triglyceride.

METHOD USED FOR ESTIMATION :

Cholesterol :- Cord blood cholesterol was done by one step kit method of Wybenga and Piliggi supplied by Sternzen Immunodiagnostic using photocalorimeter.

Principle :- Cholesterol reacts with Ferric Perchlorate in presence of ethyl acetate and sulfuric acid when hiated in boiling water bath to produce a lavender colour complex. The intensity of colour produced is proportional to the cholesterol concentration.

Reagent required :

1. Cholesterol reagent 250 ml,
2. Precipitating reagent 5 ml,
3. Standard (200 mg%) 3 ml.

Procedure :- Pipette into clean, dry test tubes labelled Blanks (B), Standard (S) and Test (T).

	(B)	(S)	(T)
. Cholesterol Reagent (1)	5 ml	5 ml	5 ml
. Distilled water	0.025 ml	-	-
. Standard (3)	-	0.025 ml	-
. Serum	-	-	0.025 ml

Mixed well and keep the tubes immediately in the boiling water bath exactly for 90 seconds. Coal them immediately to R.T. under running tap water. Measure the OD of standard (S) and test (T) against blank (B) on a colorimeter or on a spectrophotometer at 560 nm.

Calculation :

$$\text{Total cholesterol in mg\%} = \frac{\text{OD Test}}{\text{OD Standard}} \times 200$$

Triglyceride :- Cord blood triglyceride was estimated by enzymatic kit GPO/POD method, supplied by Stanzen Immuno-diagnostic with photocalorimeter. This test based on method

developed by Fossati and Prencipe with improved accuracy and stability. The advantages are the use of rapid simple one step enzymatic method.

Principle :

Triglycerides from serum hydrolysed by lipase and the glycerol that is liberated is reacts enzymatically to give a highly colored Quinoneimine dye which has an absorbance maximum 546 nm. The intensity of the colour produced is directly proportional to the concentration of triglyceride in sample.

. Triglycerides $\xrightarrow{\text{Lipase}}$ Glycerol + Fatty Acids

. Glycerol + ATP $\xrightarrow[\text{Kinase}]{\text{Glycerol}}$ Glycerol-1 — Phosphate + ADP.

. Glycerol-1-Phosphate + 02 $\xrightarrow{\text{GPO}}$ DAP + H_2 O_2

. H_2 O_2 + 4 AAP + P.chlorophenol $\xrightarrow{\text{POD}}$ Quinoneimine dye.

Reagent Required :

Reagent 1. Triglycerides Enzyme Reagent.

Reagent 2. Triglycerides Standard 200 mg%.

Reagent 1 : Dissolve the content of the vial of reagent 1 in 6 ml of deionised/distilled water by gentle swirling. Do not shake, avoid frothing.

<u>Procedure</u> : Pipette into clean dry test tubes labelled Blank (B), Standard (S) and Test (T).

	(B)	(S)	(T)
. Working Enzyme reagent	1.0 ml	1.0 ml	1.0 ml
. Distilled water	.01 ml	-	-
. Standard	-	.01 ml	-
. Serum	-	-	.01 ml

Mixed well. Incubate at 37°C for 3 minutes, then add 2 ml of distilled water/Deionized water and again mixed well and measure the O.D. of Blank (B), Standard (S) and Test (T) on photocalorimeter. Final colour is stable for 1/2 hr.

<u>Calculation</u> :

$$\text{Serum Triglycerides in mg\%} = \frac{\text{OD of (T)}}{\text{OD of (S)}} \times 200$$

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O B S E R V A T I O N S

OBSERVATIONS

A study to determine the serum levels of cholesterol and triglycerides in cord blood of newborn babies and their relationship to gestational age, birth weight and perinatal stress factors was carried out on 55 new born babies delivered at M.L.B. Medical College Hospital, Jhansi, between August 1994 to July 1995.

A total number of 55 cases were included in the present study. New born babies were classified according to their maturity, into pre-term ($<$ 37 weeks), term (37 - 41 weeks) and post-term ($>$ 41 weeks) group. There were 35 cases (63.64%) in term group and 20 (36.36%) cases in pre-term group and no cases in post-term group.

The study group was also classified into two groups on the basis of birth weight. New borns having birth weight less than 2500 gms were labelled as low birth weight babies. This group included 20 (36.36%) cases. While newborns with birth weight more than 2500 gm were designated as normal birth weight babies and this group included 35 (63.64%) cases, as shown in table 1.

The cases were classified into appropriate for gestational age (AGA), Small for gestational age (SGA) and Large for gestational age (LGA) groups. Term group comprised of 29 AGA cases and 6 SGA cases, pre-term group included 11 AGA cases, 4 SGA and 5 LGA cases. It is also evident from table 2 that maximum number of cases fell into the category of Term AGA group.

The case material was also classified according to gestational age. Accordingly, it was observed (Table 4) that 2 (3.63%) cases were less than 33 weeks of gestation, and 18 (32.72%) cases were between 34-37 weeks and 35 (63.64%) cases were in 38-41 weeks of gestation.

The sex of the babies was also given due consideration and accordingly there were 30 (54.54%) males and 25 (45.46%) female cases in the study group (Table 6).

It was tried to classify the cases according to increasing birth weight. Accordingly, the cases were distributed into various groups considering the increasing birth weight (Table 7).

Distribution indicated 1 (1.8%) cases in 1000-1500 gms range, 5 (9.09%) cases in 1501-2000 gms range, 14 (25.45%) cases in 2001-2500 gms range, 30 (54.54%) cases in 2501-3000 gms range and 5 (9.09%) cases in the group of birth weight more than 3001 gms.

An attempt was made to classify pre-term, term case material to their sex. In pre-term group 8 (40%) cases were male and 12(60%) cases were female. In term group there were 22 (62.86%) male and 13 (37.14%) female cases (Table 9).

It was also tried to classify the cases according to perinatal stress factors affecting the cases. The perinatal stress factors which were considered were prolonged labour, pregnancy induced hypertension, birth asphyxia and LSCS (Table 11).

It was seen that in few cases, more than one perinatal factor were involved and so the cases were also grouped according to the number of perinatal stress factors affecting the newborn at a time (Table 14).

SERUM CHOLESTEROL AND TRIGLYCERIDE VALUES :

All the values of serum cholesterol and triglyceride are expressed as mg/dl.

The mean ± S.D. cholesterol value observed during this study were 82.140 ± 12.763 mg/dl with range of 53.994 ± 139.984 and triglycerides were 49.460 ± 20.693 with range of 12.5 - 93.774 mg/dl.

On the comparison of the mean ± S.D. values of cholesterol and triglycerides in the low birth weight babies (LBW) (Birth weight $\angle$2500 gms) to normal birth weight ($\urcorner$2500 gms) babies. It was observed that cord

cholesterol values were higher in the LBW babies group than their normal counterparts (Birth weight >2500 gms). The differences was statistically significant. The triglyceride values were also higher in low birth weight babies than the normal weight babies. The difference was statistically not significant ($P > 0.05$).

Table - 1

Distribution of serum values of cholesterol and triglycerides in LBW and normal weight babies.

Groups of babies	No.of cases	%	Cholesterol	Triglyceride
Normal weight babies (Birth weight >2500 gms)	35	63.64	80.944$\pm$11.728	48.995$\pm$19.247
Low birth weight babies (Birth weight <2500 gms.)	20	36.36	82.741$\pm$17.054	49.526$\pm$22.972
't'			.462	1.262
'p'			>0.05	>0.05
d.f. = 53				

It is evident from table No. 2 that in the pre-term group, the cholesterol values were higher in SGA than the AGA and LGA groups and triglyceride values were higher in SGA groups. In term group, the cholesterol values were higher in SGA than AGA group.

Table - 2

Distribution of cholesterol and triglyceride values in various weight for age group (Mean $\pm$ S.D.)

Group	No.of cases	%	Cholesterol	Triglyceride
I. Pre-term : 20				
a) A.G.A.	11	55.0	79.40$\pm$5.85	40.77 $\pm$23.324
b) L.G.A.	5	25.0	78.492$\pm$6.839	38.702$\pm$4.887
c) S.G.A.	4	20.0	86.241$\pm$13.353	62.498$\pm$25.76
II.Term : 35				
a) S.G.A.	6	17.15	91.101$\pm$23.064	50.692$\pm$14.86
b) A.G.A.	29	82.85	81.400$\pm$11.32	52.560$\pm$19.551

Table - 3

Statistical analysis of various group represented in table 2.

Compared group	d.f.	Cholesterol 't'	Cholesterol 'p'	Triglyceride 't'	Triglyceride 'p'
Ia & Ib	14	0.275	>0.05	0.934	>0.05
Ia & Ic	13	2.162	<0.05	0.842	>0.05
Ib & Ic	7	1.65	>0.05	2.654	<0.01
Ia & IIa	15	2.238	<0.05	4.036	<0.001
Ia & IIb	38	0.554	>0.05	2.305	<0.05
IIa & Ic	8	0.668	>0.05	3.026	<0.01
Ib & IIa	9	2.213	<0.05	2.426	<0.01
Ib & IIb	32	0.918	>0.05	2.136	<0.05
Ic & IIb	31	1.106	>0.05	1.723	>0.05
IIa & IIb	33	2.109	<0.05	0.429	>0.05

On statistical analysis of cholesterol values in the appropriate gestational age babies in pre-term and term group, the difference is statistically not significant ($P > 0.05$). The triglycerides value show the higher values in term group. The difference were statistically significant ($P < 0.05$). As evident from table 2 & 3 that there was statistically significant difference between AGA and SGA in pre-term group ($P < 0.05$).

In table 3, compare SGA pre-term with SGA term babies. The cholesterol values were not significant ($P > 0.05$) where the triglyceride values were higher and statistically significant ($P < 0.05$). It was also clear from table 3 that cholesterol values were higher in SGA term babies as compared to AGA pre-term babies. The differences were statistically significant ($P < 0.05$) and their triglyceride values followed the same trend that was statistically highly significant ($P < 0.001$).

As has been detailed earlier, the cholesterol and triglyceride values observed with increasing gestational age (from < 33 to > 41 weeks) to observe a correlation, if any, between these parameter to increasing gestational age. It is evident from table 2 that in pre-term group (< 33 weeks and 34-37 weeks) statistically insignificant difference in cholesterol values was observed ($P > 0.05$). However, on comparison of the cholesterol

values in both groups of pre-term babies to the values observed in term babies (38-41 weeks), a statistically insignificant difference was observed ($P > 0.05$). These observation favour that there was no significant difference in cholesterol values between term and pre-term.

Table - 4

Distribution of Mean ± S.D. values of cholesterol and triglyceride according to increasing gestational age.

Gestational age group	No.of cases	%	Cholesterol	Triglyceride
< 33 weeks	2	3.63	78 ± 1.66	37.71 ±26.055
34 - 37 weeks	18	32.73	80.778±9.371	42.032±20.857
38 - 41 weeks	35	63.64	83.063±14.52	52.24 ±18.84

On comparison of various gestational group, statistically insignificant difference was observed in the cholesterol values, and the triglyceride values showed inverse relation to gestational age. The difference were statistically highly significant ($P < 0.01$).

Table - 5

Distribution of statistical analysis of table 4.

Compared group	d.f.	Cholesterol 't'	Cholesterol 'p'	Triglyceride 't'	Triglyceride 'p'
I & II	18	0.783	>0.05	4.306	<0.01
I & III	35	0.455	>0.05	2.104	<0.05
II & III	51	0.604	>0.05	2.306	<0.05

Table - 6

Distribution of Mean $\pm$ S.D. values of cholesterol and triglyceride in different sex.

Sex	No.of cases	%	Cholesterol	Triglyceride
Male	30	54.54	80.381 ± 9.84	51.261 ± 20.342
Female	25	45.46	84.258 ± 15.426	47.301 ± 20.898
		't'	1.365	0.710
		'p'	>0.05	>0.05
		d.f. = 53		

On comparison of male to female, the cholesterol value was high in male but it was statistically insignificant ($P > 0.05$). The triglyceride shows the higher value in male. It also statistically insignificant ($P > 0.05$) (Table 6).

Table - 7

Distribution of Mean ± S.D. cholesterol and triglyceride in different birth weight groups.

Birth weight (gms.)	No.of cases	%	Cholesterol	Triglyceride
1000 - 1500	1	1.81	86.659	93.744
1501 - 2000	5	9.09	96.989±25.039	58.754±24.247
2001 - 2500	14	25.45	80.229±6.953	41.664±17.696
2501 - 3000	30	54.54	81.770±10.708	50.280±20.709
3001 & above	5	9.09	75.992±9.284	50.08 ±4.460

An attempt was made to observe the mean cholesterol and triglyceride levels in different weight groups and to detect the relationship, if any, between these values and increasing birth weight. Accordingly cases were classified into different groups (weight) and cholesterol and triglyceride levels were observed (Table 7) and statistically analysed (Table 8).

Table - 8

Distribution of statistical analysis of table 7.

Compared groups	d.f.	Cholesterol 't'	Cholesterol 'p'	Triglyceride 't'	Triglyceride 'p'
II & III	17	2.368	< 0.01	2.120	< 0.05
II & IV	33	2.372	< 0.05	1.080	> 0.05
II & V	8	1.958	< 0.05	0.828	> 0.05
III & IV	42	0.495	> 0.05	1.36	> 0.05
III & V	17	1.075	> 0.05	1.25	> 0.05
IV & V	33	0.684	> 0.05	0.136	> 0.05

It is evident from table 7 that the cholesterol values were found to be higher in Ist & IInd group (1000 - 1500 gms & 1501 - 2000 gms) and lowest values in the group V viz. weighing 3001 gms and above.

On statistical analysis (Table 8) it was seen that only in these group mentioned above, a statistically significance was seen (I & V, P < 0.01, II & V, P < 0.05) however in the IIIrd and IVth group (birth weight 2001 - 2500 gms & 2501 - 3000 gms) no statistically significant difference was observed either with group II and V. The group I is not comparable having single variable.

These findings highlights the fact that highest value of cholesterol are observed in lowest birth weight group.

Contrary to cholesterol value in different birth weight group, on estimation of triglyceride a decreasing trend was observed with increasing birth weight. A detailed statistical analysis among various group is given in table 8.

It was seen that group I having a highest value but not comparable to other groups because of single variable. On comparison of group II & III, a significant difference was seen which was statistically significant ($P < 0.05$). The triglyceride values compared in other group were insignificant ($P > 0.05$).

During this study, an effort was also made to establish a correlation between male and female according to maturity.

Table - 9

Distribution of Mean ± S.D. values of cholesterol and triglyceride levels according to maturity and sex.

Groups	No.of cases	%	Cholesterol	Triglyceride
I. Pre-term : 20				
a) Male	8	40.0	77.388±5.677	42.267±21.71
b) Female	12	60.0	83.047±10.225	46.127±23.344
II. Term : 35				
a) Male	22	62.86	81.696±10.894	54.529±22.57
b) Female	13	37.14	85.376±18.941	48.366±18.119

The cholesterol values of female in both group (pre-term & term) had a higher value as compared to male. The difference of these group is statistically insignificant ($P > 0.05$).

Table - 10

Distribution of statistical analysis of table 9.

Compared groups	d.f..	Cholesterol		Triglyceride	
		't'	'p'	't'	'p'
Ia & Ib	18	1.418	>0.05	0.372	>0.05
Ia & IIa	28	1.059	>0.05	1.328	>0.05
Ia & IIb	19	1.180	>0.05	0.695	>0.05
Ib & IIa	32	0.352	>0.05	1.025	>0.05
Ib & IIb	23	0.377	>0.05	0.269	>0.05
IIa & IIb	33	0.733	>0.05	0.836	>0.05

The triglyceride values also follow the same trend. The differences was statistically insignificant.

During this study an effort was also made to see the effect of various perinatal stress factor on the cholesterol and triglyceride level of cord. We selected 4 main perinatal factors i.e. pre-eclampsic toxaemia, prolong labour (>15 hours), birth asphyxia LSCS, and observed the mean cholesterol and triglyceride value in

the affected group (Table No. 11 & 12). In all 24 cases suffered from perinatal stress, in which few cases had simultaneously two or more factors involved (Table No. 14 & 15)

Table - 11

Distribution of Mean ± S.D. of values of cholesterol and triglyceride in various group of perinatal stress factor affecting the foetus.

Sl. No.	Stress factor	No.of cases	%	Cholesterol	Triglyceride
I	Normal new born	31	56.37	81.336±10.519	41.027±17.037
II	Prolong labour	5	9.09	75.992±1.332	72.502±22.226
III	PET	4	7.27	74.786±8.865	58.703±20.711
IV	Birth Asphyxia	6	10.90	76.659±3.333	61.891±27.930
V	LSCS	21	38.18	84.317±15.921	63.025±19.87

It was observed that the cases with prolong labour $>$15 hours had higher triglyceride level (Mean ± S.D. 72.502 ± 22.26) in comparison to non-affected individuals (41.027 ± 17.037). The difference being statistically highly significant ($P < 0.001$). The Mean ± S.D. value of triglyceride cases of PET, birth asphyxia and LSCS were also high and difference were statistically significant when compared to normal newborn.

Table - 12

Distribution of statistical analysis of table 11.

Compared group	d.f.	Cholesterol 't'	Cholesterol 'P'	Triglyceride 't'	Triglyceride 'P'
I & II	34	0.915	>0.05	2.863	<0.01
I & III	33	0.695	>0.05	2.104	<0.05
I & IV	35	1.136	>0.05	2.304	<0.05
I & V	46	1.003	>0.05	2.41	<0.05
II & III	7	0.915	>0.05	0.691	>0.05
II & IV	9	0.650	>0.05	0.786	>0.05
II & V	21	1.620	>0.05	1.912	>0.05
III & IV	8	0.92	>0.05	0.649	>0.05
III & V	19	1.34	>0.05	1.364	>0.05
IV & V	22	1.52	>0.05	2.140	<0.05

The mean $\pm$ S.D. value of cholesterol was high in LSCS group compared to normal newborn. The difference was statistically insignificant ($P > 0.05$). In other perinatal factor group, the cholesterol values difference were statistically insignificant ($P > 0.05$) as shown in table 12.

We also tried to make correlation between perinatal stress factors belong to one group, and normal newborn group. When compared the triglyceride values of

stressed newborn to normal newborn. The stressed newborn had very higher value compared to normal newborn. The difference was statistically highly significant ($P < 0.001$) as shown in table 13.

Table - 13

Mean value of ± S.D. value of cholesterol and triglyceride in stress and normal new born.

Group	No.of cases	%	Cholesterol	Triglyceride
Stress new born	24	43.63	83.186±15.252	60.355±19.881
Normal new born	31	56.37	81.336±10.579	41.027±17.037
	't'		0.563	3.843
	'P'		> 0.05	< 0.001
	d.f. = 53			

The cholesterol values was 83.186 ± 15.252 in stress new born and 81.336 ± 10.519 in normal born. The difference was statistically insignificant ($P > 0.05$) (Table 13).

As few cases were affected with more than one perinatal stress factor at a time, we tried to establish a correlation, if any, between the number of factor involved

and the cholesterol & triglyceride value observed (Table 14). It was observed that the cholesterol values were slightly increased (86.866 ± 16.259) in group with one perinatal stress factor in comparison to that observed without perinatal stress (81.336 ± 10.519). But the difference was statistically insignificant ($P > 0.05$), when 2 or more stress factor involve, the cholesterol values were slightly lower in comparison to normal group. The difference were statistically insignificant ($P > 0.05$) (Table 15).

Table - 14

Distribution of Mean ± S.D. values of cholesterol and triglyceride in various perinatal stress factor affecting the fetus.

No. of perinatal factor affecting at a time	No. of cases	%	Cholesterol	Triglyceride
No perinatal stress factor	31	56.37	81.336±10.519	41.027±17.037
1 Stress factor	17	30.90	86.866±16.259	57.915±18.773
2 Stress factor	3	5.45	78.882±6.284	56.458±2.618
3 Stress factor	3	5.45	78.684±3.141	76.94 ±16.94
4 Stress factor	1	1.81	76.659 -	93.744 -

Table - 15

Distribution of statistical analysis of table 14.

Compared group	d.f.	Cholesterol 't'	Cholesterol 'p'	Triglyceride 't'	Triglyceride 'p'
I & II	46	1.430	>0.05	3.169	<0.001
I & III	32	0.393	>0.05	2.936	<0.01
I & IV	32	0.416	>0.05	3.487	<0.001
II & III	18	0.804	>0.05	0.136	>0.05
II & IV	4	1.302	>0.05	2.236	<0.05
III & IV	18	0.939	>0.05	2.817	<0.01

It was observed that the mean ± S.D. triglyceride levels exhibits an increasing trend as the number of perinatal stress factor increased. The elevated triglyceride level observed (57.915 ± 18.773) when one perinatal stress factor was considered in contrast to levels observed in unaffected individuals (41.027 ± 17.037). The difference were statistically highly significant.

Elevated triglyceride levels also observed when two perinatal stress factor, 3 perinatal stress factor, and 4 perinatal stress factor were considered in comparison to normal new born. These difference were highly significant (P <0.001 & <0.001 respectively).

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DISCUSSION

DISCUSSION

The present work was carried out to study the serum levels of cholesterol and triglyceride in cord blood of newborn babies. The study was conducted at M.L.B. Medical College, Jhansi in the Department of Paediatrics, in active collaboration with Department of Obstetrics and Gynaecology, from August 1994 to July 1995. The primary aim of study was to find out the normal values of cord cholesterol and triglyceride in term babies and to observe the correlation, if any, between their levels of prematurity, birth weight, intra-uterine growth retardation and perinatal stress factors.

The mean serum level of cholesterol of all 55 cases were observed to be 82.140 $\pm$ 12.763 mg/dl. Lower values of cholesterol ($<$75 mg/dl) were observed by many observers namely Rafstedt, Brown, Russ, Brody and Carlson, Kleenberg and Polisuk, Cress and Sharma in past. More than 90 mg/dl values of cholesterol were observed by Sadowsky, Kaplan & Lee, Fosbrooke, Mathur, Lakhtakia and Jagdish in the past. Similar finding to this were observed by Gordan & Cohn, Darmandy, Desai, Haridas and Acharya, and Kumar. Mean values of triglyceride level observed in this study was 49.461 $\pm$ 20.694 mg/dl. Less than 45 mg/dl values

were observed by Brody and Carlson, Kaplan & Lee, Fosbrooke, Cress. More than 55 mg/dl observed by Tsang, and proximity to mean value were observed by Haridas and Acharya, Kumar, and Lakhtakia.

Relation with Sex :-

In the present study, an effort was made to observe a difference, if any, between males and females regarding cholesterol and triglyceride levels. In the present study, females had apparently higher levels of cholesterol (84.258 $\pm$ 15.426) in comparison with males (80.381 $\pm$ 9.84 mg/dl), though the difference was statistically insignificant ($P > 0.05$). Similar finding also observed by Jagdish.

Triglyceride value was 52.261 $\pm$ 20.342 in males and 47.301 $\pm$ 20.898 mg/dl in female babies. The difference was statistically insignificant ($P > 0.05$).

The sex of newborn did not influence the cholesterol and triglyceride values.

Relation to gestational age :-

In this study, an attempt was made to observe a correlation, if any, between the increasing gestational age and level of cholesterol and triglyceride in cord blood. It was observed that the levels of cholesterol were apparently higher (83.063 $\pm$ 14.52) in gestational age group 38-41 weeks and exhibits a downward trend as the gestational

URE - 1

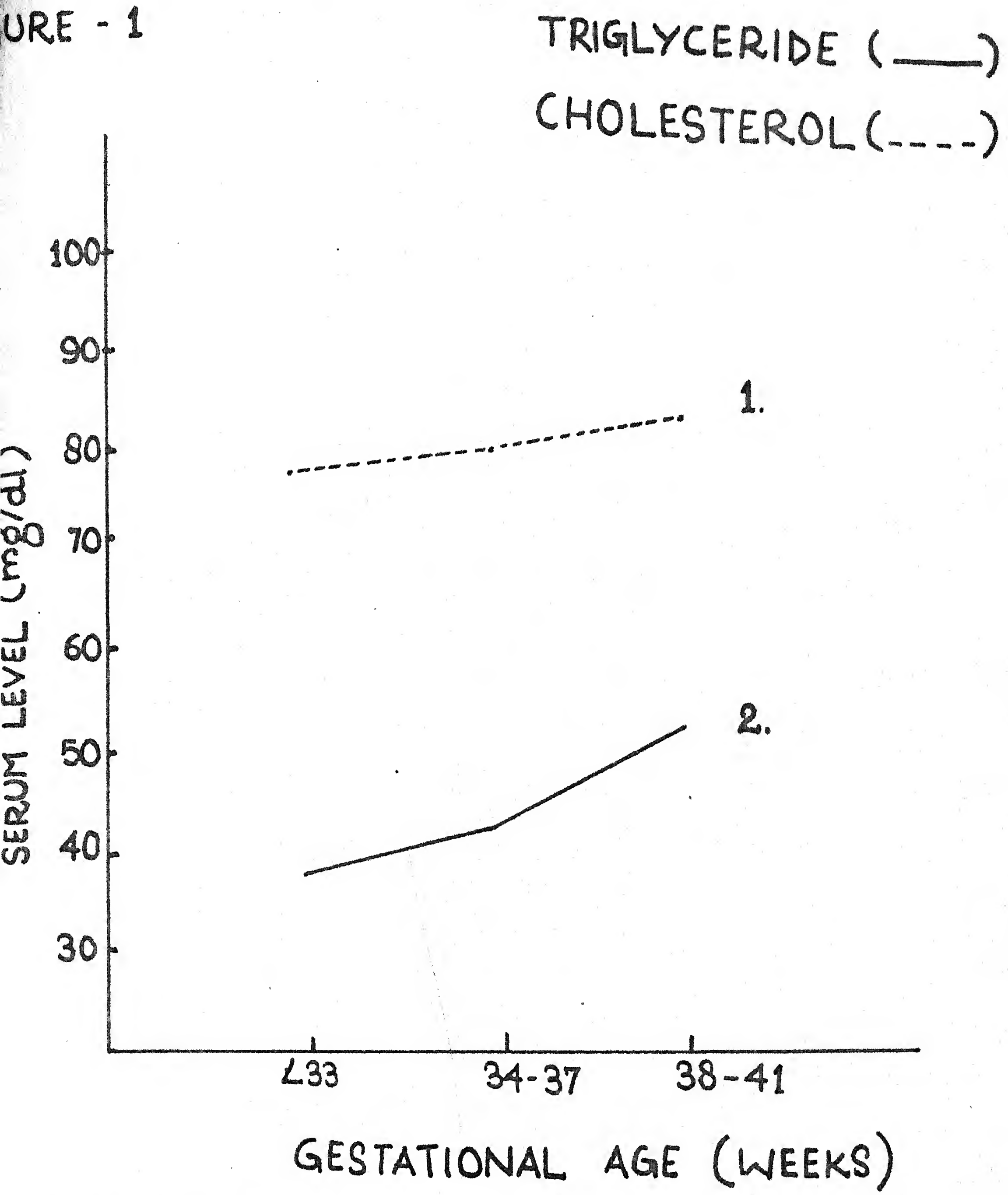

FIGURE SHOWING :-

1. RELATION OF CHOLESTEROL WITH GESTATIONAL AGE
2. RELATION OF TRIGLYCERIDE WITH GESTATIONAL AGE

age decrease. The levels of cholesterol were 80.778 ± 9.371 in 34-37 weeks gestational age group and 78.0 ± 1.66 mg/dl in $\angle$33 weeks gestational age groups (Figure 1). The difference in said group were statistically insignificant (P $\urcorner$70.05). Fosbrooke observed no significant difference in cholesterol levels with increasing gestational age.

The triglyceride levels in present group showed a positive correlation to gestational age (Table 4). The triglyceride levels were observed to be increased with gestational age (Figure 4). The values were 37.71 ± 26.055 mg/dl, 42.032 ± 20.857 and 52.24 ± 18.84 in $\angle$33 weeks, 34-37 weeks and 38-41 weeks of gestational age groups respectively. On comparison with $\angle$33 weeks gestational age group to 34-37 weeks gestational age groups, the difference were significant (P $\angle$0.05). When compared 34-37 weeks gestational age group to 38-41 weeks gestational age group, the difference were significant (P $\angle$0.05) and difference were highly significant (P $\angle$0.01) when compared with $\angle$33 weeks gestational age group to 38-41 weeks of gestational age groups. Similar trend was also observed by Fosbrooke et al (1973), that was an increasing trend in triglyceride levels along with advancement of gestational age and they also observed that triglyceride level did not increase much below 37 weeks of gestational age and beyond it the increase was significant in low birth weight groups. The lower triglyceride concentration in lower gestational

age group reflected lesser importance of fat metabolism earlier in pregnancy and as deposition of fat in adipose tissue took place mainly in the last month of pregnancy.

It was infered that cord blood cholesterol levels not influenced by gestational age and elevated cholesterol levels may indicate hypercholesterolemia and on the other hand the levels of triglyceride was affected by gestational age and an infered should not be labelled as hyperlipidemia unless the factors were considered.

Relation with birth weight :-

Due emphasis was also given to weight for age status and on observing the levels of cholesterol and triglycerides in different for age groups (Table 2 & 3). There were 11 babies of appropriate for gestational age, 5 babies of large for gestational age and 4 babies of small for gestational age in pre-term groups and in term groups, 29 babies of appropriate for gestational age and 6 babies of small for gestational age. It was seen that in pre-term group, the cholesterol value was higher in small for gestational age (86.241 $\pm$ 13.353 mg/dl) in comparison with appropriate for gestational age and large for gestational age (79.404 $\pm$ 5.85 mg/dl and 78.492 $\pm$ 6.829 mg/dl respectively). The difference was statistically significant ($P < 0.05$) when compared appropriate for gestational age with small for gestational age.

Difference was statistically insignificant ($P > 0.05$) when compared appropriate for gestational age with large for gestational age. Similar to this study, Kumar (1989) observed higher value of cholesterol in low birth weight babies in comparison with normal birth weight babies. The difference was statistically significant. Contrast to this study, Haridas and Acharya (1984) had lower values of cholesterol in small for gestational age in comparison with pre-term appropriate for gestational age group. The difference was statistically insignificant. Similar finding was also observed by Fosbrooke (1973) that the cholesterol levels did not vary much between term, pre-term and small for gestational age group.

In term group, small for gestational age had higher levels of cholesterol (91.101 ± 23.064 mg/dl) in comparison with appropriate for gestational age group (81.4 ± 11.32 mg/dl). The difference was statistically significant ($P < 0.05$). When compared pre-term appropriate for gestational age with term appropriate for gestational age group, the term appropriate for gestational age had apparently higher levels of serum cholesterol (81.400 ± 11,32 mg/dl) in comparison with pre-term appropriate for gestational age (79.404 ± 5.85 mg/dl) group. The difference was statistically insignificant ($P > 0.05$) and when term small for gestational age compared with pre-term small for gestational age, the difference was statistically

insignificant ($P > 0.05$). Similar finding was also observed by Fosbrooke (1973) that the cholesterol levels did not vary much between term, pre-term and small for gestational age group. The authors concluded that cord blood cholesterol levels were not influenced by birth weight and elevated cholesterol levels may indicate hypercholesterolemia.

The elevated level of cholesterol in small for gestational age groups attributed to intra-uterine malnutrition and in response to this mobilisation of intra-uterine fetal adipose store takes place and it is comparable with those found in marasmic children due malnutrition developing postnatally.

In table 2 it was seen that pre-term small for gestational age group had higher levels of triglycerides (62.498 ± 25.76 mg/dl) in comparison with appropriate for gestational age and large for gestational age groups (40.77 ± 23.324 mg/dl and 38.702 ± 4.887 mg/dl respectively). The difference were statistically highly significant ($P < 0.01$). Similar to this study, Haridas and Acharya (1984) had observed the higher values of triglyceride in pre-term small for gestational age in comparison with pre-term appropriate for gestational age. The difference was statistically significant. Kumar (1989) also observed significantly higher levels in pre-term small for gestational age 104.50 ± 20.80 mg/dl in comparison with pre-term

appropriate for gestational age 70.6 $\pm$ 32.68 mg/dl and in term small for gestational age 55.34 $\pm$ 23.95 mg/dl in comparison with term appropriate for gestational age 35.27 $\pm$ 17.49 mg/dl respectively. Fosbroke also observed higher values of triglyceride 45.4 $\pm$ 28.9 in small for gestational age in comparison with 29.5 $\pm$ 12.0 mg/dl in term babies. The difference was significant ($P < 0.01$).

The raised levels of triglyceride seen in small for gestational age group babies can be explained by considering them to be malnourished in intra-uterine life. Thereby switching over from carbohydrate metabolism to fat metabolism for energy requirements.

Term small for gestational age had triglyceride levels (52.692 $\pm$ 14.86 mg/dl) in comparison with term appropriate for gestational age (50.560 $\pm$ 19.551 mg/dl). The difference was statistically insignificant ($P > 0.05$). This observation was similar to those observed by Haridas and Acharya (1984). In contrast to this study, Kumar (1989) had observed significant higher value of triglyceride in term small for gestational age 55.34 $\pm$ 23.95 mg/dl in comparison with term appropriate for gestational age 35.27 $\pm$ 17.49 mg/dl.

On observing the cholesterol and triglyceride levels in different groups of increasing birth weight (table 7 & 8). It was evident from table 7 that the cholesterol values were found to be high in Ist & IInd

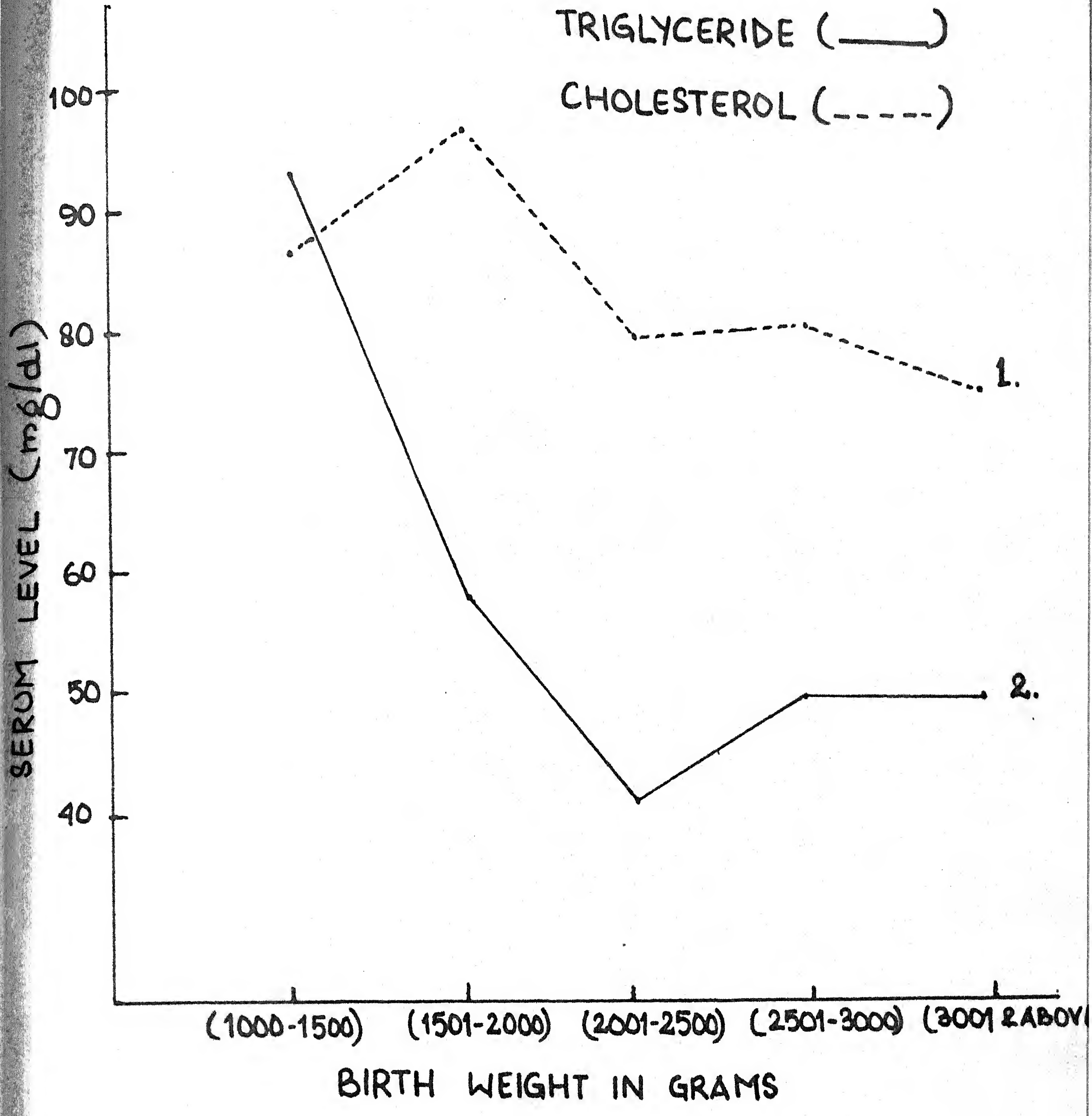

FIGURE SHOWING :-

1. RELATION OF CHOLESTEROL WITH INCREASING BIRTH WEIGH
2. RELATION OF TRIGLYCERIDE WITH INCREASING BIRTH WEIGH

groups (1000 - 1500 gm & 1501 - 2000 gms) as compared with group V (3001 gms & above). The cholesterol values were 86.659; 96.989 ± 25.039 and 75.992 ± 9.284 mg/dl respectively in said groups. The difference were statistically highly significant ($P < 0.01$).

Similar to cholesterol levels, triglyceride levels demonstrated an inversely proportion to the birth weight that is highest level observed in lowest birth weight groups (93.744 mg/dl) and lowest value (41.664 ± 17.696) in birth weight 2001 - 2500 gms. It was also lowered in birth weight groups 3001 and above. The difference was statistically significant ($P < 0.05$) for group IInd & IIIrd. Group Ist had single case. Therefore statistically not comparable. Fosbrooke and Whartan (1973) had high values of triglyceride in low birth weight babies in comparison to normal birth weight babies, difference were statistically significant.

The highest values of triglyceride in low birth weight babies can possibly be explained on the basis of these group mainly comprised of small for gestational age, low birth weight babies and term small for gestational age and as earlier all these groups have demonstrated higher triglyceride levels which have been explained by stress of delivery and intra-uterine malnutrition.

<u>Relation to perinatal stress factors</u> :-

The cholesterol of normal newborn and stress newborn babies were 81.336 ± 10.579 mg/dl and 83.186 ± 15.252 mg/dl respectively. The difference were statistically insignificant.

On observing the level of cholesterol in babies affected by these factors individually (Table 11 & 12), in prolong labour the level was 75.992 ± 1.332 in comparison with 81.336 ± 10.579 mg/dl in normal newborn. The difference was insignificant ($P > 0.05$). Similar findings were observed by Tsang (1974) and Cress (1977).

Babies suffered by birth asphyxia showed cholesterol level 76.659 ± 3.33 mg/dl in comparison with 81.336 ± 10.579 mg/dl in normal newborn. The difference was insignificant ($P > 0.05$). Similar finding was observed by Tsang (1974).

Babies affected by pre-eclamptic toxaemia had cholesterol level 74.786 ± 8.865 mg/dl and 81.336 ± 10.579 mg/dl in normal newborn. The difference was insignificant ($P > 0.05$). Similar finding were observed by Sobte (1994) and Cress (1977).

Babies delivered by caesarean section had cholesterol levels 84.317 ± 15.921 mg/dl and in normal newborn babies it was 81.336 ± 10.579 mg/dl. The difference was insignificant ($P > 0.05$). Similar finding were observed by Cress (1977) and Sobti (1994).

The triglyceride levels of normal newborn and stress newborn babies were 41.027 ± 17.037 mg/dl and 60.355 ± 19.881 mg/dl respectively. The difference were statistically highly significant ($P < 0.01$).

In babies affected by prolong labour, the triglyceride level was 72.502 mg/dl and in normal newborn it was 41.027 ± 17.037 mg/dl. The difference were highly significant ($P < 0.001$). Similar finding was observed by Tsang (1974), Cress (1977) and Sobti (1994).

On observing the babies affected by pre-eclamptic toxaemia the level was 58.703 ± 20.711 mg/dl and in normal newborn it was 41.027 ± 17.037 mg/dl. The difference was highly significant ($P < 0.01$). Similar finding were observed by Tsang (1974), Cress (1977), Lakhtakia (1990) and Sobti (1994).

Babies suffered by birth asphyxia had the triglyceride level 61.89 ± 27.930 mg/dl and in normal newborn it was 41.027 ± 17.037 mg/dl. The difference was highly significant ($P < 0.01$). Similar finding were observed by Tsang (1974) and Cress (1977).

Babies delivered by caesarean section had the triglyceride level 63.025 ± 19.87 mg/dl and in normal newborn it was 41.027 ± 17.035 mg/dl. The difference was highly significant ($P < 0.01$). Similar findings were observed by Tsang (1974), Cress (1977) and Sobti (1994).

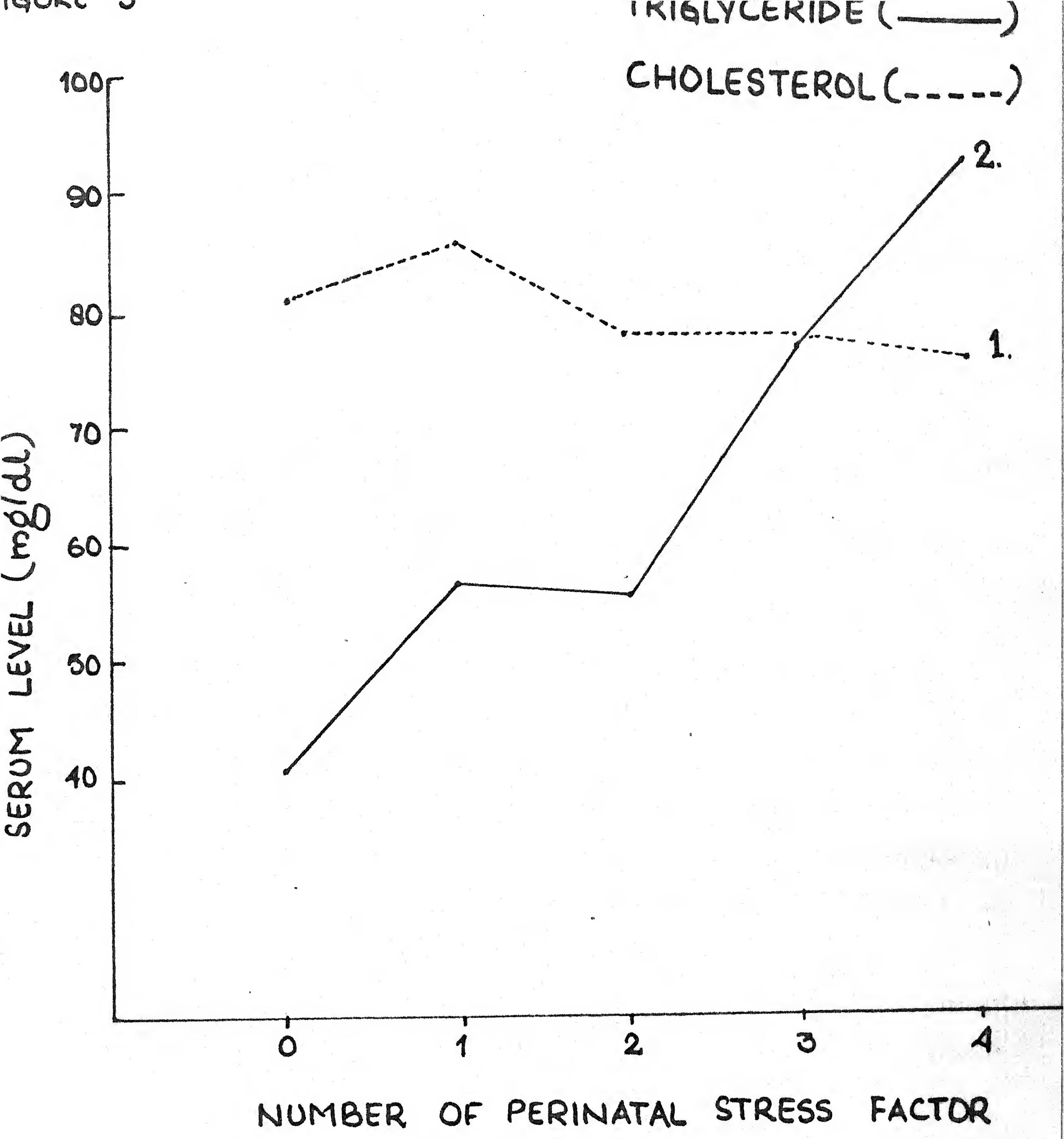

FIGURE SHOWS :-

1. RELATION OF CHOLESTEROL WITH INCREASING NUMBER OF PERINATAL STRESS FACTOR.
2. RELATION OF TRIGLYCERIDE WITH INCREASING NUMBER OF PERINATAL STRESS FACTOR.

The triglyceride values were high in prolong labour in comparison with normal newborn. The difference was statistically significant ($P < 0.01$). The triglyceride levels exhibiting a direct positive correlation with increasing number of perinatal stress factors and the differences were highly significant ($P < 0.001$). The triglyceride levels were high (56.458 ± 2.618 mg/dl) when two perinatal stress factors were involved in comparison to normal newborn (41.027 ± 17.037 mg/dl). The differences were statistically highly significant ($P < 0.01$). It is also observed that the triglyceride levels were further increased when three or four factors were involved and differences were highly significant ($P < 0.01$) as shown in Figure 3 . Under normal circumstances foetal nenergy requirement are nearly exclusively catered by oxidation of carbohydrate stress as respiratory Quotient at birth is nearly unit. Stress in utero, in birth canal leads to high energy requirements and thereafter depletion of glycogen and carbohydrate stores, so the energy requirements are then catered by fat mobilisation and utilisation along with increased synthesis of triglycerides in the liver. Also during stress sympathetic system is stimulated and catecholamines elicit an immediate response as adipose tissue mobilisation and utilisation. All these mechanisms collectively lead to increased triglyceride levels at birth during stress. These findings were in close proximity to

those of Tsang and Glueck who also observed significantly raised levels of triglyceride under stressful conditions individually and collectively (P $\angle$ 0.001). They also observed that the triglyceride levels significantly increased with the increase in number of perinatal stress factor (P $\angle$ 0.001). Cress had observed the effect of perinatal stress factor over the biochemical parameter in cord blood. They observed elevated triglyceride levels in prolong labour, birth asphyxia, leaking P/V and pre-eclamptic toxaemia. Tsang and Glueck, and Cress had observed elevated triglyceride level in increased perinatal stress factors. Lakhtakia et al (1990) had also observed raised triglyceride level in babies born to mother with essential hypertension.

From the above said discussion it was inferred that triglyceride levels were mostly affected by perinatal stress factors in comparison to cholesterol level.

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SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present work was carried out to study the serum levels of cholesterol and triglyceride in cord blood of newborn babies. The study was conducted at M.L.B.Medical College, Jhansi, in the Department of Paediatrics in active collaboration with Department of Obstetrics & Gynaecology, from August 1994 to July 1995. The primary aim of study was to find out the normal values of cord cholesterol and triglyceride in term babies and to observe the correlation, if any, between their levels to prematurity, birth weight, intra-uterine growth retardation and perinatal stress factor.

The mean serum level of cholesterol of the newborns studied was 82.140 $\pm$ 12.763 mg/dl and mean triglyceride level observed to be 49.461 $\pm$ 20.694 mg/dl. In present study there were 30 males and 25 females. Both the groups had no difference in serum cholesterol and triglyceride levels statistically.

Relation to gestational age :-

The cholesterol values were statistically insignificant in different increasing gestational age

groups. The values were 83.063 ± 14.52 mg/dl in gestational age group 38-41 weeks, 80.778 ± 9.371 mg/dl in 34-37 weeks of gestational age and 78 ± 1.66 mg/dl in less than 33 weeks of gestational age, but the triglyceride levels showed direct correlation with increasing gestational age groups. The levels were 37.71 ± 26.055 mg/dl, 42.032 ± 20.857 mg/dl and 52.24 ± 18.84 mg/dl in $\angle$ 33 weeks, 34-37 weeks and 38-41 weeks of gestational age groups respectively.

Relation with birth weight :-

There were 11 babies of appropriate for gestational age, 5 babies of large for gestational age and 4 babies of small for gestational age in pre-term group and in term group, 29 babies of appropriate for gestational age and 6 babies of small for gestational age group.

The mean cholesterol value was statistically higher in pre-term small for gestational age group (86.241 ± 13.353 mg/dl) when compared with pre-term appropriate for gestational age group (79.404 ± 5.85 mg/dl). In term group also, small for gestational age group had higher levels of cholesterol statistically (91.101 ± 23.064 mg/dl) in comparison with appropriate for gestational age group (81.4 ± 11.32 mg/dl).

The mean triglyceride level was statistically higher in pre-term small for gestational age group (62.498 ± 25.76 mg/dl) when compared with pre-term appropriate for

gestational age (40.77 ± 23.324 mg/dl) and pre-term large for gestational age (38.702 ± 4.887 mg/dl). Term small for gestational age group had statistically indifferent level of triglyceride (52.692 ± 14.86 mg/dl) when compared with term appropriate for gestational age group (50.560 ± 19.551 mg/dl).

On observing the cholesterol and triglyceride levels in different groups of birth weight, it was seen that there was linear correlation with the increasing birth weight. The difference was significant ($P < 0.05$).

Relation with Perinatal stress factors :-

The serum cholesterol values were 83.186 ± 15.252 mg/dl in stress newborns and 81.336 ± 10.579 mg/dl in normal newborns. The difference was statistically insignificant. On observing the levels of cholesterol in babies affected by perinatal stress factors individually like prolong labour, pre-eclamptic toxaemia, birth asphyxia and caesarean section respectively, the cholesterol values showed no indifference statistically in comparison with normal counterparts. The values were 75.992 ± 1.332 mg/dl, 74.786 ± 8.865 mg/dl, 76.659 ± 3.333 mg/dl and 84.137 ± 15.921 mg/dl. When each group compared with normal newborns (81.336 ± 10.519), the difference was statistically insignificant, even in presence of more than 2 stress factors. Thus cord cholesterol values were not affected by perinatal stress factors.

The triglyceride values of stress newborns and normal newborn babies were 60.355 ± 19.881 mg/dl and 41.027 ± 17.037 mg/dl respectively. The difference was statistically highly significant ($P < 0.001$). On observing the levels of triglyceride in babies affected by perinatal stress factor individually like prolong labour, birth asphyxia, pre-eclamptic toxaemia and caesarean section. The respective triglyceride values were 72.502 ± 22.26 mg/dl, 58.703 ± 20.711 mg/dl, 61.891 ± 27.930 mg/dl and 63.025 ± 19.87 mg/dl, when compared with normal counterpart 41.027 ± 17.037 mg/dl. The difference were statistically significant.

Correlation was also found in triglyceride levels with increasing number of stress factors. The triglyceride levels were 57.915 ± 18.773 mg/dl, 56.458 ± 2.618 mg/dl, 76.94 ± 16.94 and 93.744 mg/dl when one, two, three and four perinatal stress factors influenced respectively. The differences were highly significant when compared with normal newborns (41.027 ± 17.037 mg/dl). Thus triglyceride level increased with increasing number of perinatal stress factors.

CONCLUSION

Following conclusions were drawn from observations of this study :

1. The mean cholesterol and triglyceride was 82.140 $\pm$ 12.763 mg/dl and 49.46 $\pm$ 20.693 mg/dl respectively.

2. Sex made no difference in serum levels of cholesterol and triglyceride.

3. Triglyceride levels had direct correlation with gestational age.

4. Cholesterol level was higher in $<$ 2.0 kg birth weight in comparison with more than 3.0 kg birth weight.

5. Triglyceride level had inversely proportional correlation with birth weight.

6. Small for date babies had significantly higher level of triglyceride in comparison with appropriate for gestational age.

7. Perinatal stress factors mainly affect the triglyceride levels. The triglyceride level increases with increasing number of perinatal stress factors.

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